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Comparative study on effect of roasting treatment on nutritional properties of flaxseed

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Abstract
The present work was proposed to study the effect of roasting on physico-chemical and nutritional characteristics of flaxseed were investigated. Roasting of flaxseed was carried out at temperatures of 160-180^{0}C for 8-10 min. The comparative study of roasted and non-roasted flaxseeds was evaluated for chemical and mineral composition. Result obtained showed protein and fiber content in roasted and non-roasted flaxseeds was found to be 19.46%, 19.85% and 6.35%, 5.56% respectively. While, the carbohydrate content varied significantly among non-roasted and roasted flaxseed was noticed to be 25.9% and 28.54% respectively. Further, comparative analysis of mineral composition of non-roasted and roasted flaxseed showed that calcium content was 215 and 233 mg/100g, phosphorus 820 and 630 mg/100g, iron 5.56 and 2.85 mg/100g respectively. It could be concluded that roasting of flaxseed shown to have good nutritional value as compared to non-roasted flaxseeds.

Keywords: Flaxseed, roasting, nutritional properties, chemical composition, mineral composition

Introduction
Flaxseed, or Linseed (*Linum usitatissimum*), popularly known as Alsi, Jawas, Aksebija in Indian languages, is a blue flowering rabbi crop and a member of family *Linaceae*. The plant is native to west Asia and the Mediterranean. As the source of linen fiber flax has been cultivated since at least 5000 BC, today it is mainly grown for its oil (Berglund, 2002). The spherical fruit capsules contain two seeds in each of five compartments. The seed is flat and oval with a pointed tip, smooth glossy surface. It varies in color dark brown to yellow (Freeman, 1995) [7]. The texture of flaxseed is crisp and chewy possessing a pleasant nutty taste (Carter, 1996) [5].
Annual production of flax was 3.06 million tons and Canada is the world's largest producer of flax (about 38% of total production) (Anonymous, 2000) [2]. Globally, Flaxseed is grown as either oil crop or a fiber crop with fiber linen derived from the stem of fiber varieties and oil from the seed of linseed varieties (Diederichsen *et al.,* 2003; Vaisey-Genser *et al.,* 2003) [6, 15].
Flaxseed is being used extensively for the development of functional foods. The components of flaxseed, identified to exhibit the health benefits are fibre, lignans and linolenic acid (Omega-3 fatty acid). Moreover, flaxseed is a good source of high quality protein, soluble fibres and phenolic compounds (Mohammad, 2011) [8].
The flaxseed protein has been found to be effective in lowering plasma cholesterol and triacylglycerides. Flaxseed fibre, both soluble and insoluble is considered to reduce the blood glucose and cholesterol levels (Mridula D. *et al.,* 2013) [9]. Flax seed contains polyunsaturated fatty acids in high rates, saturated fatty acid in low rates, fibre in low rates with plenty of potassium, and small amounts of magnesium, iron, copper, zinc and various vitamins (Bloedon *et al*., 2004) [4]. Recently, flaxseed has shown potential for CVD prevention due to its composition of ALA, soluble fibres, and lignans. These components are believed to protect the cardiovascular system by reducing serum cholesterol, platelet aggregation and inflammatory markers (Shahdadi *et al*., 2013) [12].

Materials and Methods
Materials
The good quality of Flaxseeds was procured from Parbhani local market.

Methods
Preparation of sample
Roasting of flaxseed
Roasting of whole flaxseed were done using conventional oven at temperature of 160-180°C

for different time treatments like 5, 10, and 15 min. In this study, 500 gram batch was used for each roasting process and three replications was applied for each roasting time. For all flaxseed products, each replication was extracted separately and then each of the extracted oils and defatted flaxseed samples were analyzed independently. Each flaxseed product was roasted using two aluminum pan at the same time in the oven for each replication and the batch was not stirred during the roasting process to prevent the temperature changes in the oven and also the thickness of the batch was very low.

Analytical Methods

The flaxseeds were analyzed for the chemical composition namely moisture, protein, fat, ash, crude fibre and minerals composition includes calcium, phosphorus, iron was carried out as per the method given by (AOAC, 2005) [1]. Nutrients were analyzed in duplicate and results were expressed on dry weight basis.

Proximate Analysis

Different chemical properties of samples were analyzed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

Moisture content

Moisture content was determined as per the method given by AOAC (2005) [1]. It was calculated using following formula.

$$\% \text{ Moisture content} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

Ash

Drying the sample at 100 ^{0}C and churned over an electricheater. It was then ashes in muffle furnace at 550 0C for 5 hrs. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Initial Weight of sample}} \times 100$$

Fat

AOAC (2005) [1] method using soxhlet apparatus was used todetermined crude fat content of the sample. The percent ofcrude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (2005) [1] method. Percentage of nitrogen and protein calculated by thefollowing equation:

$$\% \text{ Nitrogen} = \frac{TS - T_B \times \text{Normality of acid} \times 0.014 \times \text{Dilution factor}}{\text{Aliquot taken} \times \text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml),
TB = Titre volume of Blank (ml), 0.014= M eq. of N
% Protein = Nitrogen × 6.25

Total carbohydrate

Total carbohydrate content of the samples was determined as total carbohydrate by difference, calculated by subtracting the measured protein, fat, ash and moisture from 100.

Determination of minerals

Two grams of defatted sample was weighed and heated at 550ºC. Then, the obtained ash were digested with concentrated Hydrochloric acid (HCL) on hot plate. The digested material was then filtered using what man No. 42 filter paper and the final volume made to 100ml with distilled water that was further used for analysis with respects to iron, calcium, potassium, contents by using methods Ranganna S. (1986) [10].

Results and Discussion

Physical properties of Flaxseed

Various physical properties of Flaxseed were determined, and results obtained are presented in Table 1.

Table 1: Physical Parameters of flaxseed.

Physical Parameters	Observation
Colour	Light Brown
Shape	Flat oval
Length (mm)	5.25±0.02
Width (mm)	2.15±0.01
Thickness (mm)	0.80±0.01
Wt. of 1000 Seed (g)	6.95±0.03

*Each value represents the average of three determinations

The data given in Table 1 revealed various physical characteristics of flaxseed such as colour is an important characteristic for determining the visual acceptance. The colour of flaxseed was found to be light brown to tan, whereas, flat to elongated oval in shape. Different dimensional properties like length, width, and thickness was measured and showed 5.25, 2.15 and 0.80 (mm) respectively. The results for 100 kernel weight was reported to 6.95 (g) respectively. Results reported are in close agreement with these findings of Singh *et al.*, (2011) [14].

Chemical and mineral composition of non-Roasted and Roasted Flaxseed

The data pertaining to various chemical and mineral properties such as moisture, fat, carbohydrate, protein, ash and crude fiber of roasted and non-roasted flaxseeds were determined and results obtained and illustrated are Table 2 and Table 3 respectively.

Table 2: Proximate composition of Flaxseed.

Chemical properties	Mean Value (%)	
	Non Roasted Flaxseed	Roasted Flaxseed
Moisture	6.7±0.02	2.57±0.02
Ash	2.35±0.01	2.25±0.01
Total Protein	19.85±0.03	19.46±0.03
Total Carbohydrate	25.9±0.1	28.54±0.2
Crude Fibre	5.56±0.02	6.35±0.01
Crude Fat	36.9±0.03	35.76±0.3

*Each value represents the average of three determinations

Results given in above Table. 2 indicated that the mean value for moisture, protein, fat, ash, carbohydrate and crude fiber content of non-roasted and roasted flaxseed varied between 6.7 to 2.57%, 19.85 to 19.46%,36.9 to 35.76, 2.35 to 2.25, 25.9 to 28.54% and 5.56 to 6.35 respectively. Results reported are in close agreement with these findings of Pant and Awasthi (2015) [11].

Table 3: Mineral composition of Flaxseeds

Minerals (mg/100g)	Non Roasted Flaxseed	Roasted Flaxseed
Calcium (Ca)	233±0.1	215±0.02
Phosphorus (K)	630±0.1	820±0.1
Iron (Fe)	2.85±0.02	5.56±0.03

The mineral composition of flaxseed were analyzed and results revealed that the minerals such as phosphurs and iron increased with roasting from 630 to 820 mg/100g and 2.85 to 5.56 mg/100g, respectively. Result reported are in close agreement with these findings of shahzad *et al*., (2008) [13].

Conclusion

In the present study Roasting of flaxseed was carried out under the controlled condition of heating. From the result, it can have concluded that the chemical, minerals and nutritional properties were significantly influenced by the roasting process. A significantly decreases fat and protein. Move over, the minerals content, i.e. K and Fe increase by the roasting process. Therefore, roasting can improve the nutritional value and reducing anti nutritional factor.

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